REMARKS

Solely in order to expedite prosecution, claim 8 has been canceled without prejudice/disclaimer to the subject matter embodied thereby, rendering the objection/rejection thereagainst moot.

Claims 1, 5 and 9 are independent.

Claim 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Liu et al. '139 ("Liu"); claim 5 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Ignatiev et al. '332 ("Ignatiev"); and claim 9 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Hsu et al. '674 ("Hsu") in view of Liu. These rejections are respectfully traversed for the following reasons.

It is noted that the Examiner relies exclusively on Liu for allegedly disclosing a method of applying electric pulses generally, which method is now included in each of claims 1, 5 and 9. However, it is respectfully submitted that Liu is silent as to the specifically claimed method of the present invention. Indeed, Liu (as well as Ignatiev) are cited on pages 3 and 1, respectively, of Applicants' specification as admitted prior art. As recognized solely by Applicants, Liu's disclosed method "causes significant problems in the stability of operation and production yield of a memory device" (page 3, lines 5-6 of Applicants' specification) and "fails to disclose an initialization method of the resistance value of the PCMO material" (page 21, lines 4-6 of Applicants' specification).

Liu at best illustrates that variable-resistance materials have resistance values which increase or decrease according to the polarity of an applied electric pulse. However, Applicants have further considered the changing resistance of such materials and learned that conventional

processes such as in Liu are deficient with regard to the ***initial*** properties of the variable-resistance materials. That is, according to conventional processes (e.g. Liu), at the time of formation of a variable-resistance material film, it is not known whether the resistance value of the film increases/decreases by a specific amount when an electric pulse of a specific polarity is applied. Accordingly, a desired resistive state can not be achieved even when an electric pulse is applied, thereby making it difficult to use the material for a memory device.

Turning to Liu, as shown in Fig. 4a thereof, the resistance value increases if an electric pulse having the same polarity as the first-applied electric pulse (-12V) is applied. On the other hand, as shown in Fig. 4b thereof, the resistance value decreases if an electric pulse having the same polarity as the first-applied electric pulse (+51V) is applied. In this regard, Liu is silent as to how the relationship between the polarity of the applied electric pulse and the increase/decrease of the resistance value is determined. In other words, Liu does not describe why the relationship between the polarity of the applied electric pulse and the increase/decrease of the resistance value is entirely opposite in Figs. 4a and 4b.

One of the objectives of the present invention is directed to obviating this deficiency of Liu and the conventional method. Indeed, as described beginning on page 17 of Applicants' specification with regard to one exemplary embodiment of the present invention (emphasis added),

> ... when the first electric pulse is applied between the electrodes **1** and **3** of the variable-resistance material film **2** which is ***in the initial state*** (state where an electric pulse is not yet applied between the electrodes **1** and **3** after the formation of the film **2** and the resistance value is R_{ini}) as illustrated with, e.g., FIG. **3** or FIG. **5**, the resistance value of the variable-resistance material film **2** decreases ***irrespective*** of the polarity of the applied electric pulse.

Only Applicants have recognized and considered this phenomenon, and conceived of a novel methodology to utilize it for enabling a desired resistive state to be achieved more accurately even when an electric pulse is applied. The cited prior art is silent as to such an initialization.

As further described on page 17 of Applicants' specification, when an electric pulse having the same polarity as that of the first applied electric pulse is applied between the electrodes **1** and **3**, the resistance value of the variable-resistance material film **2** decreases; and when an electric pulse having the opposite polarity to that of the first applied electric pulse is applied between the electrodes **1** and **3**, the resistance value of the variable-resistance material film **2** increases. Accordingly, the relationship between a subsequently-applied electric pulse and the increase/decrease of the resistance value can be determined according to the polarity of ***the first electric pulse*** applied to the variable-resistance material film **2**. That is, when the polarity of the subsequently-applied electric pulse is the same as that of the first applied electric pulse, the resistance value of the variable-resistance material film **2** decreases; and when the polarity of the subsequently-applied electric pulse is opposite to that of the first applied electric pulse, the resistance value of the variable-resistance material film **2** increases.

According to the present invention, therefore, as described on page 17 of Applicants' specification, it can be made possible to uniquely determine whether the resistance value of the variable-resistance material is increased or decreased by an electric pulse having a predetermined polarity. To this end, an electric pulse ***for initialization*** which has a specific polarity can be applied to the variable-resistance material, whereby the polarity of the electric pulse which increases or decreases the resistance value for recording can be uniquely determined.

Claim 1 has been amended to clarify this distinction over the cited prior art. For example, step (a) of claim 1 embodies applying the electric pulse ***in an initial state***, thereby

clarifying the distinction over the first electric pulse of Liu shown in Figs. 4a and 4b which is not applied in an initial state. That is, as noted above and described on page 17 of Applicants' specification, when an electric pulse is applied to the variable-resistance material in an initial state (i.e., state when material not yet subjected to an electric pulse), the resistance value of the variable-resistance material film decreases ***irrespective*** of the polarity of the applied electric pulse. In direct contrast, as shown in Figs. 4a and 4b of Liu, the respective first pulses are NOT applied in an initial state as evidenced by the fact that the resistances ***both*** decrease and increase dependent on the polarity of the applied pulse. That is, the first electric pulse described in Liu is applied to a variable-resistance material that HAS already been subjected to application of an electric pulse after a film formation, so that Liu is silent as to the initialization pulses.

It follows that Liu does not disclose the polarity of the electric pulse applied in the initial state. Accordingly, the relationship between the polarity of the electric pulse and the increase/decrease of the resistance value can not be uniquely determined. In this regard, Liu further does not disclose or suggest steps (b) and (c) recited in claim 1. Liu at best may appear to disclose simply a general application of an electric pulse, which is NOT applied in an initialization step, between the first and second electrodes to increase/decrease the resistance value of the variable-resistance material. In short, Liu does not disclose a method in which an initialization takes place to enable determination of a relationship between pulse and resistance so as to more accurately apply the pulses subsequent to the initialization application. Rather, the beginning of Liu's method is directed merely to the subsequent application of pulses after initialization so that obtained resistances can only be determined rather than targeted.

Claims 5 and 9 are submitted to be patentable over the cited prior art for at least reasons similar to those discussed above regarding claim 1.

Indeed, with respect to claim 9, neither Hsu nor Liu discloses or suggests a method for uniquely determining the relationship between the polarity of the electric pulse to be applied to each of two variable-resistance materials and the increase/decrease of the resistance value of each variable-resistance material as discussed above, much less complementarily changing the resistance values of the two variable-resistance materials.

As anticipation under 35 U.S.C. § 102 requires that each and every element of the claim be disclosed, either expressly or inherently (noting that "inherency may not be established by probabilities or possibilities", *Scaltech Inc. v. Retec/Tetra*, 178 F.3d 1378 (Fed. Cir. 1999)), in a single prior art reference, *Akzo N.V. v. U.S. Int'l Trade Commission*, 808 F.2d 1471 (Fed. Cir. 1986), based on the forgoing, it is submitted that the cited prior art does not anticipate claims 1, 5 and 9, nor any claim dependent thereon. The Examiner is directed to MPEP § 2143.03 under the section entitled "All Claim Limitations Must Be Taught or Suggested", which sets forth the applicable standard for establishing obviousness under § 103:

> To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. (citing *In re Royka*, 180 USPQ 580 (CCPA 1974)).

In the instant case, the cited prior art does not "establish *prima facie* obviousness of [the] claimed invention" as recited in claims 1, 5 and 9 because the cited prior art fails the "all the claim limitations" standard required under § 103.

Under Federal Circuit guidelines, a dependent claim is nonobvious if the independent claim upon which it depends is allowable because all the limitations of the independent claim are contained in the dependent claims, *Hartness International Inc. v. Simplimatic Engineering Co.*, 819 F.2d at 1100, 1108 (Fed. Cir. 1987). Accordingly, as claims 1, 5 and 9 are patentable for the reasons set forth above, it is respectfully submitted that all claims dependent thereon are also

patentable. In addition, it is respectfully submitted that the dependent claims are patentable based on their own merits by adding novel and non-obvious features to the combination.

Based on the foregoing, it is respectfully submitted that all pending claims are patentable over the cited prior art. Accordingly, it is respectfully requested that the rejections under 35 U.S.C. § 102/103 be withdrawn.

CONCLUSION

Having fully responded to all matters raised in the Office Action, Applicants submit that all claims are in condition for allowance, an indication for which is respectfully solicited. If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, the Examiner is requested to call Applicants' attorney at the telephone number shown below. To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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